U.S. Patent Application No. 10/711,700
FIS920040258US1

ATTACHMENT

INDEPENDENT CLAIMS 1 AND 13 CURRENTLY BEING PROSECUTED

1. (previously presented) A copper interconnect comprising:

an impure copper seed layer derived from an impure copper source with a content of impurities that is deposited on a barrier layer, said barrier layer prevents substantial diffusion of copper through to an underlying insulating layer;

an impure copper derived from an impure copper source with a content of impurities that fills an opening in said underlying insulating layer that is deposited on said impure copper seed layer; and,

wherein material composition of said seed layer is substantially the same as material composition of said impure copper fill.

13. (proposed tentative amendment) A copper interconnect comprising:

an insulating layer that has an opening;

a barrier layer that prevents substantial diffusion of copper through to said underlying insulating layer that is deposited on said underlying insulating layer and lines said opening;

an impure copper seed derived from an impure copper seed source with a content of impurity that is deposited on said barrier layer and fills said opening;

an impure copper derived from an impure copper source with a content of impurities that fills said opening in said underlying insulating layer that is deposited on said impure copper seed; and

wherein material composition of said ~~seed layer~~ impure copper seed is substantially the same as material composition of said impure copper fill.

RESPONSE TO CLAIM REJECTION - 35 U.S. §103 AS APPLIED TO INDEPENDENT CLAIMS 1 AND 13 OF U.S. PATENT APPLICATION NO. 10/711,700

Claims 1 and 13 stand rejected under 35 U.S. §103 as obvious over U.S. Patent No. 6,709,562 Andricacos et al. ("Andricacos"). Applicants respectfully traverse the rejection because Andricacos fails to disclose, teach, or suggest at least two requirements of the claimed invention, namely (1) a impure copper seed and (2) that the material composition of the impure copper seed is substantially the same as the material composition of the impure copper fill.

Both independent Claims 1 and 13 require an impure copper seed. As described in the specification as originally filed, the impure copper seed "reduces edge erosions" and "suppresses dendritic formation." (Specification, ¶25). The Examiner claims that use of an impure copper seed, by Applicants own admission, is well known in the art. (Final Office Action, pg. 3, line 19-pg. 4, line 2 and pg. 5, lines 8-12). Applicants stated in paragraph 20 of the specification as originally filed, which the Examiner cites as Applicants' admission, that "such impure copper sources are generally well known in the art." (Specification, ¶20). Applicants, however, did not state in paragraph 20 of the specification as originally filed that "such impure copper seed layers are generally well known in the art." In fact, Applicants stated in the Background of the Invention section that "historically a pure copper seed layer was used." (Specification, ¶6). Applicants then elaborated that such pure copper seed layer was used because "pure copper was known to be more conductive than aluminum." (Specification, ¶6). Therefore, contrary to the Examiner's statement impure copper seed layers are not well known in the art, either by Applicants own admission, or as disclosed, taught, or suggested by Andricacos.

Andricacos is directed to an interconnection wiring that produces void-free and seamless submicron structures through the use of "electroplating from a bath containing additives." (Andricacos, col. 1, lines 25-30, Clms. 1, 48 & 49). Andricacos does not disclose an impure copper seed layer. Any reference to seed layer 5 in Andricacos is to a copper, Cu, seed layer. (See e.g. Andricacos, col. 4, lines 57-58, col. 9, line – 40 – col. 10, line 10). Therefore, Andricacos does not disclose an impure copper seed layer, which is required by independent claim 1 and 13. For at least this reason, Andricacos does not disclose, teach or suggest the claimed invention.

Both Claims 1 and 13 further require that "the material composition of said seed layer is substantially the same as material composition of said impure copper fill." The Examiner admits that Andricacos does not teach this limitation, but states that such limitation "would have been obvious to one having ordinary skill in the art at the time the invention was made to use the same material composition for both the impure copper seed layer and the impure copper fill, since it would lower the cost of making the product." (Final Office Action, pg. 3, lines 5-10). Applicants respectfully traverse the Examiner's first assertion, namely that use of an impure copper seed layer would have been obvious. In addition, Applicants respectfully traverse the Examiner's second assertion, namely that use of an impure copper seed would reduce cost. With respect to the first assertion that use of an impure copper seed layer would have been obvious, as discussed herein above, pure copper seed layer was used because pure copper was known to be more conductive than aluminum. Further, with respect to the second assertion, that use of an impure copper seed would reduce cost, is not an obvious conclusion. In fact,

Applicants assert that the cost of fabricating an impure copper seed source will more likely increase the cost of interconnect fabrication.